CORRELATION OF MAP UNITS

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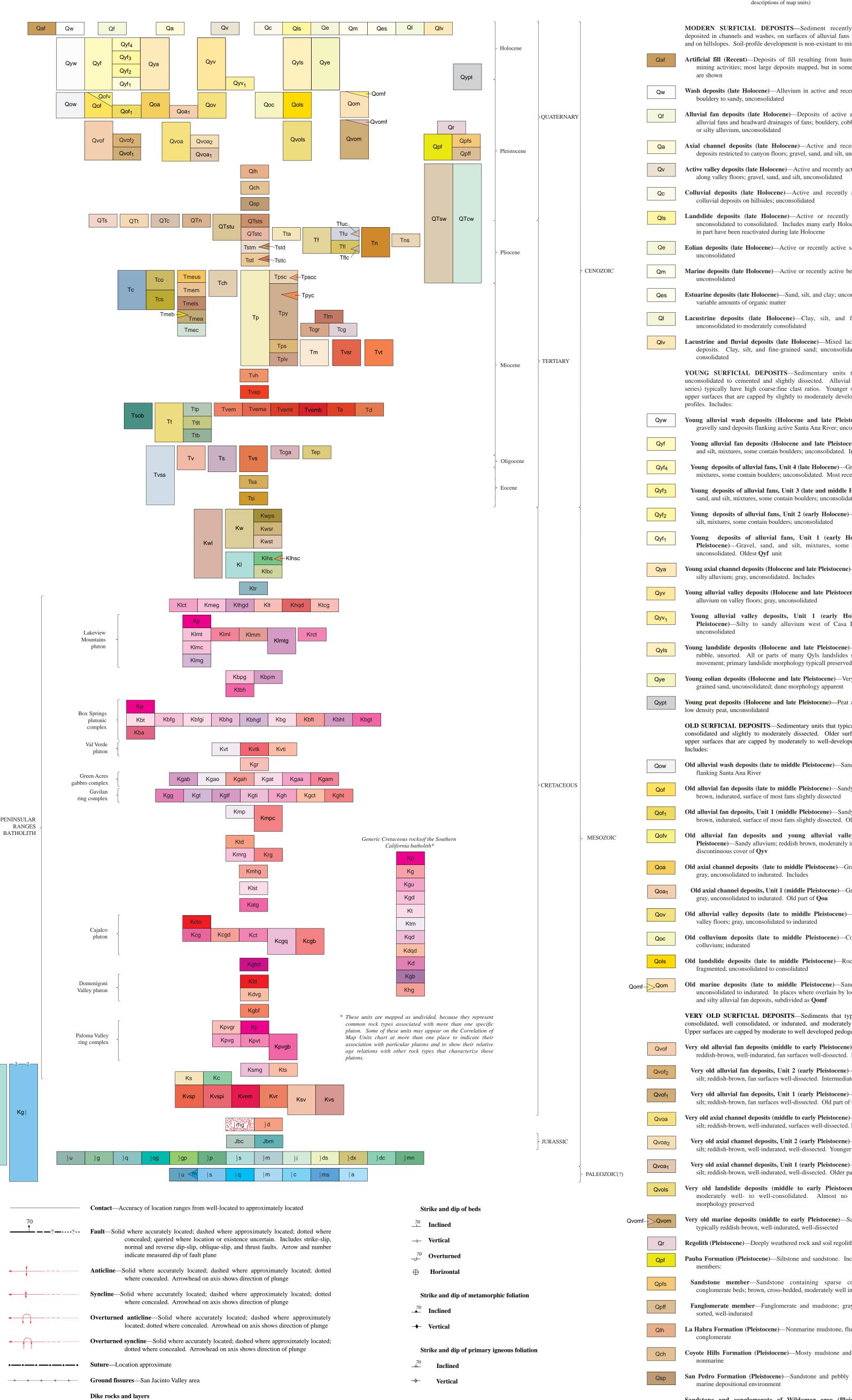
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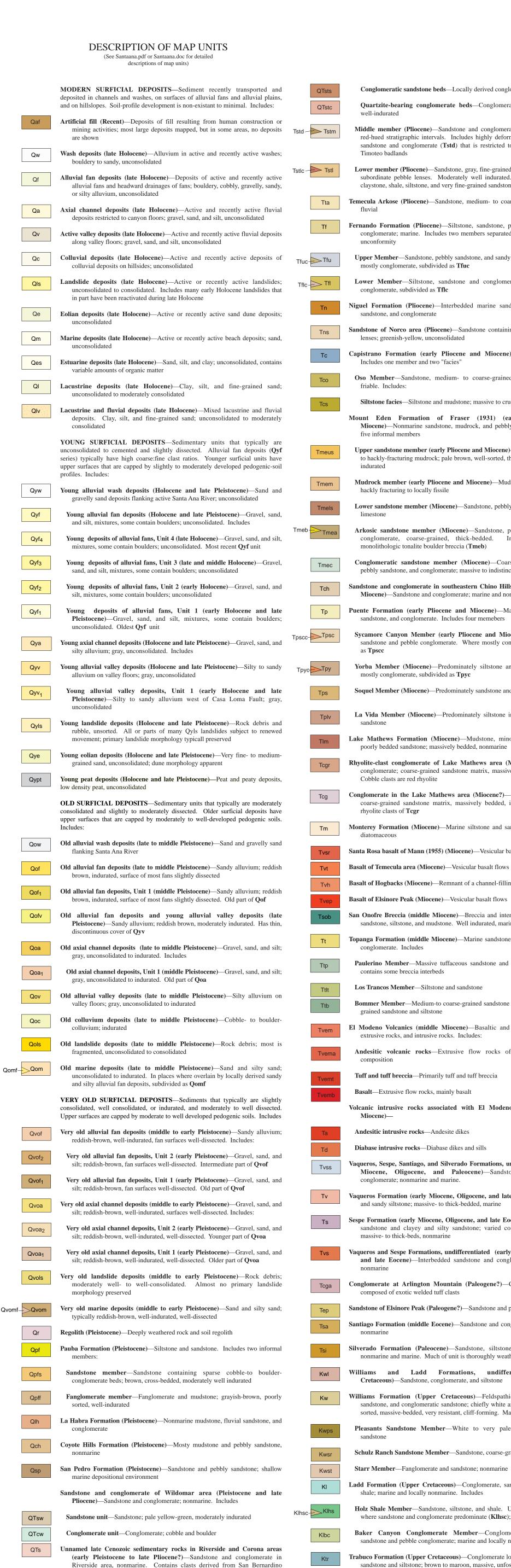


Bearing and plunge of linear features \longrightarrow_{70} Inclined Correlation of Map Units and abbreviated Description of Map Units

SANTA ANA 30' X 60' QUADRANGLE, SOUTHERN CALIFORNIA, VERSION 1.0

Compiled by D. M. Morton

Digital preparation by



Mountains. Local clasts in area southeast of Riverside

gray, coarse-grained, moderately indurated. Includes:

conglomerate on Paleocene(?) surface

Basalt of Hogbacks (Miocene)—Remnant of a channel-filling basalt flow Basalt of Elsinore Peak (Miocene)—Vesicular basalt flows San Onofre Breccia (middle Miocene)—Breccia and interbedded conglomerate, sandstone, siltstone, and mudstone. Well indurated, marine Topanga Formation (middle Miocene)—Marine sandstone, siltstone, and locally conglomerate. Includes Paulerino Member—Massive tuffaceous sandstone and thin bedded siltstone; contains some breccia interbeds **Los Trancos Member**—Siltstone and sandstone Bommer Member-Medium-to coarse-grained sandstone interbedded with finegrained sandstone and siltstone El Modeno Volcanics (middle Miocene)—Basaltic and andesitic, tuffaceous extrusive rocks, and intrusive rocks. Includes Andesitic volcanic rocks—Extrusive flow rocks of primarily andesitic Tuff and tuff breccia—Primarily tuff and tuff breccia **Basalt**—Extrusive flow rocks, mainly basalt Volcanic intrusive rocks associated with El Modeno Volcanics (middle Andesitic intrusive rocks—Andesite dikes Diabase intrusive rocks—Diabase dikes and sills Vaqueros, Sespe, Santiago, and Silverado Formations, undifferentiated (early Miocene, Oligocene, and Paleocene)—Sandstone, siltstone, and conglomerate; nonmarine and marine. Vaqueros Formation (early Miocene, Oligocene, and late Eocene)—Sandstone and sandy siltstone; massive- to thick-bedded, marine Sespe Formation (early Miocene, Oligocene, and late Eocene)—Conglomeratic massive- to thick-beds, nonmarine Vaqueros and Sespe Formations, undifferentiated (early Miocene, Oligocene, and late Eocene)—Interbedded sandstone and conglomerate; marine and Conglomerate at Arlington Mountain (Paleogene?)—Cobble conglomerate; composed of exotic welded tuff clasts Sandstone of Elsinore Peak (Paleogene?)—Sandstone and pebbly sandstone Santiago Formation (middle Eocene)—Sandstone and conglomerate, marine and Silverado Formation (Paleocene)—Sandstone, siltstone, and conglomerate; nonmarine and marine. Much of unit is thoroughly weathered. Williams and Ladd Formations, undifferentiated (Upper **Cretaceous**)—Sandstone, conglomerate, and siltstone Williams Formation (Upper Cretaceous)—Feldspathic sandstone, pebbly sandstone, and conglomeratic sandstone; chiefly white and brown hues, poorly sorted, massive-bedded, very resistant, cliff-forming. Marine. Includes Pleasants Sandstone Member-White to very pale colored feldspathic Schulz Ranch Sandstone Member—Sandstone, coarse-grained; marine **Starr Member**—Fanglomerate and sandstone; nonmarine Ladd Formation (Upper Cretaceous)—Conglomerate, sandstone, siltstone, and shale; marine and locally nonmarine. Includes Holz Shale Member—Sandstone, siltstone, and shale. Unit subdivided locally where sandstone and conglomerate predominate (Klhsc); entire unit is marine Baker Canyon Conglomerate Member—Conglomerate, conglomeratic sandstone and pebble conglomerate; marine and locally nonmarine(?) Trabuco Formation (Upper Cretaceous)—Conglomerate locally interbedded with sandstone and siltstone: brown to maroon, massive, unfossiliferous, nonmarine Conglomerate of Temescal area (early Pleistocene to late Pliocene?)—Cobble Conglomeratic sedimentary rocks of Riverside West 7.5' quadrangle (early Pleistocene to late Pliocene?)—Conglomerate in Riverside area, nonmarine. Upper part contains boulders derived from Peninsular Ranges; lower part contains cobbles derived from San Bernardino Mountains Late Cenozoic sedimentary rocks of Norco area (early Pleistocene to late Pliocene?)—Conglomerate and conglomeratic sandstone in Norco area, nonmarine. Contains cobbles derived locally and from Transverse Ranges San Timoteo beds of Frick (1921) (Pleistocene and Pliocene)—Nonmarine sandstone and conglomerate. Includes three informal members Upper member (Pleistocene)—Interbedded sandstone and conglomerate;

Conglomeratic sandstone beds—Locally derived conglomeratic sandstone Quartzite-bearing conglomerate beds—Conglomerate, quartzite-bearing, Middle member (Pliocene)—Sandstone and conglomerate; contains abundant red-hued stratigraphic intervals. Includes highly deformed sandstone, pebbly sandstone and conglomerate (Tstd) that is restricted to western part of San Lower member (Pliocene)—Sandstone, gray, fine-grained, well-sorted; contains subordinate pebble lenses. Moderately well indurated. Includes interval of Temecula Arkose (Pliocene)—Sandstone, medium- to coarse-grained, indurated, Fernando Formation (Pliocene)—Siltstone, sandstone, pebbly sandstone, and Lakeview Mountains pluton conglomerate; marine. Includes two members separated by regional erosional Upper Member—Sandstone, pebbly sandstone, and sandy conglomerate. Where Lower Member—Siltstone, sandstone and conglomerate. Where mostly tonalite and granodiorite Niguel Formation (Pliocene)-Interbedded marine sandstone, conglomeratic Sandstone of Norco area (Pliocene)—Sandstone containing local conglomerate Capistrano Formation (early Pliocene and Miocene)—Marine sandstone. Oso Member—Sandstone, medium- to coarse-grained, massively bedded, **Siltstone facies**—Siltstone and mudstone; massive to crudely bedded, friable monzogranite. Includes: Mount Eden Formation of Fraser (1931) (early Pliocene and Miocene)—Nonmarine sandstone, mudrock, and pebbly sandstone. Includes Upper sandstone member (early Pliocene and Miocene)—Sandstone and fissle to hackly-fracturing mudrock; pale brown, well-sorted, thin-to medium-bedded, Kbfg Mudrock member (early Pliocene and Miocene)—Mudrock, dark gray-green, Lower sandstone member (Miocene)—Sandstone, pebbly sandstone, and minor Arkosic sandstone member (Miocene)—Sandstone, pebbly sandstone, and conglomerate, coarse-grained, thick-bedded. Includes tongues of Conglomeratic sandstone member (Miocene)—Coarse-grained sandstone, gray, porphyritic, foliated Sandstone and conglomerate in southeastern Chino Hills (early Pliocene and Puente Formation (early Pliocene and Miocene)—Marine shale, siltstone, Sycamore Canyon Member (early Pliocene and Miocene)—Predominately sandstone and pebble conglomerate. Where mostly conglomerate, subdivided heterogeneous, foliated Yorba Member (Miocene)—Predominately siltstone and sandstone. Where La Vida Member (Miocene)—Predominately siltstone interbedded with some Lake Mathews Formation (Miocene)—Mudstone, minor conglomerate, and Rhyolite-clast conglomerate of Lake Mathews area (Miocene?)— Cobble conglomerate; coarse-grained sandstone matrix, massively bedded, indurated. Conglomerate in the Lake Mathews area (Miocene?)—Cobble conglomerate; coarse-grained sandstone matrix, massively bedded, indurated. Lacks red Monterey Formation (Miocene)—Marine siltstone and sandstone; siliceous and weathers dark brown nearly aphanitic, massive pluton, undifferentiated sandstone and clayey and silty sandstone; varied colored, poorly defined to strong alteration medium-grained quartz latite porphyry; near-equal amounts of each Granodiorite and gabbro, undifferentiated—Intermixed granodiorite and

aphanitic-to very fine-grained, Granite of the Riverside area (Cretaceous)—Leucocratic biotite granite; mediumto coarse-grained, massive to faintly foliated Mount Hole Granodiorite (Cretaceous)—Hornblende-biotite granodiorite; pale La Sierra Tonalite (Cretaceous)—Biotite-hornblende tonalite; medium gray, weak Granodiorite of Arroyo del Toro pluton (Cretaceous)—Biotite-hornblende granodiorite; light gray, medium-grained, massive, homogeneous Cajalco pluton (Cretaceous)—Monzogranite, granodiorite, and tonalite; lithologically diverse. Widespread tourmalinized rock. Includes Tourmalinized monzogranite and granodiorite—Massive tourmaline rock, commonly containing minor amounts of quartz and felsic minerals. Product of pervasive tourmalinization of monzogranite and granodiorite Monzogranite—Hornblende-biotite monzogranite and lesser granodiorite; fine-**Granodiorite**—Biotite and hornblende-biotite monzogranite and granodiorite; Tonalite—Biotite-hornblende tonalite, massive Granodiorite and quartz latite, undifferentiated—Intermixed granodiorite and

Gabbroic dikes, Domenigoni Valley area (Cretaceous)—Hornblende gabbro;

Domenigoni Valley pluton (Cretaceous)—Granodiorite to tonalite; relatively

Quartz latite dikes—Biotite, biotite-hornblende, and hornblende quartz latite;

Granodiorite to tonalite of Domenigoni Valley—Hornblende-biotite

Fine-grained hornblende gabbro, Rail Road Canyon area

Paloma Valley Ring Complex (Cretaceous)—Composite ring structure composed

Pegmatite dikes of Paloma Valley Ring Complex—Leucocratic pegmatite dikes

Monzogranite to granodiorite—Biotite monzogranite, and less abundant

hornblende-biotite granodiorite; gray, medium=grained, hypidiomorphic-

of granophyre, pegmatite, granite, granodiorite, and tonalite. Includes

(Cretaceous)—Hornblende gabbro; fine-grained dikes, sills, and small plutons

black, relatively fine-grained, massive

granular, massive

uniform. Cut by gaurtz latite dikes. Includes:

light to dark gray, fine-grained, massive to well-foliated

granodiorite to tonalite; contains equant mafic inclusions

Granophyre—Porphyritic granophyre; gray, very fine-grained

Tonalite—Biotite-hornblende tonalite; foliated Monzogranite of Tres Cerritos (Cretaceous)—Biotite monzogranite; leucocratic, medium- to coarse-grained, subporphyritic Granodiorite and gabbro, undifferentiated-Mixed biotite granodiorite and Lakeview Mountains pluton (Cretaceous)—Predominently biotite-hornblende Monzogranite of Squaw Mountain (Cretaceous)—Biotite monzogranite; coarse-**Pegmatite dikes**—Granitic, rare earth-bearing pegmatites grained, moderately leucocratic, massive Tonalite—Biotite-hornblende tonalite containing no potassium-feldspar; Tonalite of Slaughterhouse Canyon (Cretaceous)—Biotite-hornblende tonalite; medium- to coarse-grained, massive to foliated, dark gray, fine-grained, massive Leucocratic rocks—Plagioclase-quartz rock; white. Occurs as locallized Generic Cretaceous granitic rocks of the southern California batholith Granitic pegmatite dikes (Cretaceous)—Pegmatitic textured granitic dikes; Melanocratic rocks—Melanocratic and hypermelanic rock consisting leucocratic, most are roughly tabular bodies primarily of biotite and hornblende. Occurs as lenticular masses Granitic dikes (Cretaceous)—Variety of leucocratic granitic dikes composed Comb-layered gabbro—Gabbro, comb-layered. Found along south margin of mainly of quartz and alkali feldspars Granite, undifferentiated (Cretaceous)—Granite; leucocratic, fine- to coarse-Hypersthene-hornblende gabbro—Hypersthene-hornblende gabbro; forms small masses in Lakeview Mountains Granodiorite, undifferentiated (Cretaceous)—Intermediate composition Lakeview Mountains tonalite and granodiorite, undifferentiated—Intermixed granitic rocks, mainly biotite-hornblende and biotite granodiorite Tonalite, undifferentiated (Cretaceous)—Mainly biotite-hornblende tonalite Tonalite of Reinhardt Canyon pluton (Cretaceous)—Biotite-hornblende tonalite; gray, medium-grained, most is well foliated Tonalite and mafic rocks, undifferentiated (Cretaceous)—Mainly biotitehornblende tonalite containing mixed with subequal amounts of mafic Monzogranite of Bernasconi Pass (Cretaceous)—Biotite and biotite-hornblende monzogranite; pale tan- to tan-weathering, medium grained, hypidiomorphicinclusions. Inclusion borders mostly gradational and ill-defined granular or porphyritic, foliated. Includes Quartz diorite, undifferentiated (Cretaceous)—Mainly biotite-hornblende Migmatitic rocks within monzogranite of Bernasconi Pass quartz diorite; coarse-grained (Cretaceous)—Monzogranite containing abundant masses of mafic rock Diorite and quartz diorite, undifferentiated (Cretaceous)-Mainly mixed Tonalite of Bernasconi Hills (Cretaceous)—Biotite hornblende tonalite; gray, biotite-hornblende quartz diorite and hornblende diorite medium-grained, hypidiomorphic-granular, massive to indistinctly foliated Diorite, undifferentiated (Cretaceous)—Mainly hornblende diorite; fine- to Box Springs plutonic complex (Cretaceous)—Chiefly tonalite, granodiorite, and medium-grained, massive Gabbro (Cretaceous)—Hornblende gabbro; medium- to very coarse-grained, Granitic pegmatite dikes—Granitic pegmatite dikes, some containing rare-Heterogeneous granitic rocks (Cretaceous)—Includes heterogeneous, **Biotite tonalite**—Biotite tonalite; massive, but some has faint, regular layering compositionally diverse granitic rocks mostly of tonalitic and granodiorite composition, but includes some monzogranite and gabbro Biotite granodiorite and tonalite—Biotite granodiorite and tonalite; foliated End rocks of Southern California batholith Biotite granodiorite and tonalite containing abundant inclusions—Biotite granodiorite and tonalite; contains abundant mesocratic inclusions Serpentinite (Cretaceous)—Serpentinite within Santiago Peak Volcanics; Heterogeneous porphyritic granodiorite—Granodiorite and subordinate greenish-brown, highly deformed, slickensided tonalite; porphyritic, heterogeneous with respect to mineral composition Carbonate-silicate rock (Cretaceous)—Carbonate-silicate rock spatially assoicated with serpentinite (**Ks**): reddish-brown Layered heterogeneous porphyritic granodiorite—Granodiorite; porphyritic, has pronounced layering, heterogeneous with respect to grain size Santiago Peak Volcanics (Cretaceous)—Andesitic basalt, andesite, dacite, and rhyolite: mainly extrusive rocks, but some associated volcaniclastic rocks Porphyritic granodiorite—Biotite granodiorite and subordinate tonalite; light Intrusive rocks associated with Santiago Peak Volcanics Biotite-hornblende tonalite—Tonalite; light-to medium-gray, medium- to (Cretaceous)—Hypabyssal dikes, sills and small intrusions coarse-grained, foliated. Color index averages about 25 Estelle Mountain volcanics of Herzig (1991) (Cretaceous)—Rhyolite and rare Heterogeneous biotite tonalite—Biotite tonalite; light-gray, inequigranular, andesite; heterogeneous mix of extrusive and volcaniclastic rocks medium- to coarse-grained, foliate. Heterogeneous with respect to composition Rhyolite of Estelle Mountains volcanics of Herzig (1991) Heterogeneoous granodiorite and tonalite—Hornblede-biotite tonalite and (**Cretaceous**)—Rhyolite; relatively homogeneous extrusive rocks granodiorite; light-to medium-gray, medium- to coarse-grained, texturally Intermixed Estelle Mountain volcanics of Herzig (1991) and Cretaceous(?) sedimentary rocks (Cretaceous?)—Rhyolitic volcanic rocks and Mesozoic sedimentary rocks. Tectonically and probably stratigraphically mixed Amphibolitic gabbro—Hornblende-gabbro; dark gray to black, fine- to medium-Intermixed Estelle Mountain volcanics of Herzig (1991) and Mesozoic sedimentary rocks (Mesozoic)—Predominantly Mesozoic metasedimentary Val Verde pluton (Cretaceous)—Biotite-hornblende tonalite. Includes: rocks, but including some volcanic rocks Val Verde tonalite—Biotite-hornblende tonalite; gray, medium grained, foliated Deformed granitic rocks of Transverse Ranges province (Mesozoic)—Deformed Potassium feldspar-bearing tonalite—Biotite-hornblende tonalite; contains Mesozoic sedimentary rocks. Includes U small amounts of potassium feldspar, heterogeneous Mylonitic and cataclastic granitic rocks—Cataclastic granodiorite, tonalite, and Inclusion-rich tonalite—Tonalite; contains abundant melanocratic inclusions, quartz diorite, fine- to coarse-grained most with compositionally gradational borders Diorite-Hornblende-biotite diorite and quartz diorite; medium- to coarse-Granophyre (Cretaceous)—Granophryic-textured granitic rock; pale gray, grained, massive to incipiently foliated Bedford Canyon Formation (Jurassic)—Interlayered argillite, slate, graywacke, Green Acres gabbroic complex (Cretaceous)—Olivine-pyroxene-hornblende impure quartzite, and small masses of limestone; slightly metamorphosed. gabbro; heterogeneous with respect to composition. Includes Heterogeneous mixture of olivine, pyroxene, and hornblende **Marble** (**limestone**)—Fine-grained limestone marble; gray-weathering **gabbros**—Olivine-pyroxene-hornblende gabbro; variable composition Mesozoic metasedimentary rocks, undifferentiated (Mesozoic)—Quartz-bearing Olivine gabbro—Olivine-gabbro; predominatly coarse-grained metasedimentary rocks, chiefly biotite schist; includes unknown Mesozoic metasedimentary rocks and rocks of other designated Mesozoic units Hornblende-rich gabbro—Hornblende gabbro; fine- to medium-grained, **Graywacke** (**Mesozoic**)—Predominately lithic metagraywacke Troctolite—Subporphyritic troctolite; contains large phenocrysts of anorthitic Quartz rich rocks (Mesozoic)—Impure quartzite and quartz-rich metasandstone Intermixed quartzite and graywacke (Mesozoic)—Intermixed impure quartzite Anorthositic gabbro—Gabbro; abundant plagioclase of labradorite to anorthite composition. Leucocratic, gray-weathering Intermixed graywacke and phyllite (Mesozoic)—Intermixed lithic Metagabbro—Metamorphosed gabbro. Occurs as small masses included within mixed granitic rocks in southern part of Lakeview Mountains Phyllite (Mesozoic)—Phyllite, black, fissile Gavilan ring complex (Cretaceous)—Monzogranite to tonalite, latter Schist (Mesozoic)—Wide variety of fissile schist including andalusite biotite predominates; complex composed of wide variety of granitic rocks. Includes schist, cordierite biotite schist, sillimanite biotite schist, and less commonly Hypersthene monzogranite—Hypersthene monzogranite; black, massive, garnet-bearing schist Marble (Mesozoic)-Light colored tremolite and diopside-bearing marble and Massive-textured tonalite—Biotite-hornblende tonalite, hypersthene-bearing; massive, relatively heterogeneous composition, brown-weathering, Interlayered phyllite (or schist) and quartzite (Mesozoic)—In low metamorphic grade rocks, relatively pure quartzite interlayered with phyllite. In higher grade Foliated tonalite—Biotite hornblende tonalite; medium grained, foliated metamorphic rocks, quartzite interlayered with biotite schist Tonalite containing abundant mesocratic inclusions—Biotite-hornblende Metadunite and serpentinite (Mesozoic)—Talc-bearing olivine dunite and dunite tonalite; relatively fine-grained. Contains abundant, small, platy mesocratic altered to magnesite-bearing serpentinite; brown-weathering Amphibole and pyroxene-bearing rocks associated with metadunite-Hypabyssal tonalite—Tonalite and subordinate granodiorite; fine-grained to **serpentinite** (Mesozoic)—Heterogeneous mixture of amphibolite, pyroxenite, Coarse-grained biotite-hornblende tonalite—Biotite-hornblende tonalite; Marble associated with metadunite (Mesozoic)—Silicate-bearing marble; pale coarse-grained to extremely coarse-grained gray, coarse-grained, spatially associated with dunite Heterogeneous tonalite—Biotite-hornblende tonalite; admixed with biotite Manganese-bearing rocks (Mesozoic)—Quartz-rich metasedimentary rocks hornblende granodiorite. Heterogeneous with respect to composition containing black manganese-oxide and silicate minerals Micropegmatite granite (Cretaceous)—Micropegmatitic granite; leucocratic, has Paleozoic(?) rocks, undifferentiated (Paleozoic?)—Biotite schist, quartzite, gneiss, and lesser amounts of hornblende gneiss, marble and associated skarn Micropegmatite and granodiorite of Cajalco pluton, undifferentiated and calc-silicate rock. Coarse- and very coarse-grained marble bodies (m) (Cretaceous)—Micropegmatitic granite and granitic rocks of the Cajalco Biotite Schist (Paleozoic?)—Biotite schist and biotite-quartz-feldspar schist; Tonalite dikes of Mount Rubidoux (Cretaceous)—Mafic-rich tonalite; fine- to medium- to dark-gray, fine-grained Impure quartzite (Paleozoic?)—Quartzite; impure, light-gray to light-greenish-Granite of Mount Rubidoux (Cretaceous)—Fayalite-hypersthene-biotitegray, fine-to medium-grained, layered to massive hornblende granite; coarse-grained, black, massive Marble (Paleozoic?)—Marble; white to light-gray, locally bluish-gray, and blue,

Intermixed Paleozoic(?) schist and gneiss and Cretaceous granitic rocks (Cretaceous and Paleozoic?)—Intermixed Paleozoic(?) schist and gneiss and Cretaceous granitic rocks, mostly of tonalite and granodiorite composition REFERENCES

Calc-silicate rocks (Paleozoic?)—Heterogeneous, massive to well-layered calc-

Marble and schist, undifferentiated (Paleozoic?)—Intermixed marble, calc-

Intermixed Mesozoic schist and Cretaceous granitic rocks

Amphibolite (Paleozoic?)—Black hornblende-plagioclase amphibolite

(Mesozoic)—Heterogeneous mixture of schist and granitic rocks

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coarse- to extremely coarse-grained

silicate rock, and biotite schist

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Mann, J.F., 1955, Geology of a portion of the Elsinore fault zone, California: Califonria Div. Mines Special Report 43, 22 p.

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Quartz Monzonite Monzodiorite Classification of plutonic rock types (from IUGS, 1973, and Streckeisen, 1976) A, alkali feldspar; P, plagioclase feldspar; Q, quartz.

Tonalite of Lamb Canyon (Cretaceous)—Hornblende-biotite tonalite; massive, Granite of Mount Eden (Cretaceous)—Granite; white to gray, leucocratic, medium-to coarse-grained, massive to foliated

Granodiorite of Tucalota Hills (Cretaceous)—Biotite granodiorite; massive, light-

tonalite; medium-grained, foliated, intensely fractured Hypersthene quartz diorite (Cretaceous)—Hypersthene-biotite quartz diorite; fine-to medium-grained, massive

Rocks of the Southern California batholith

claystone, shale, siltstone, and very fine-grained sandstone (**Tstlc**)

mostly conglomerate, subdivided as Tfuc

conglomerate, subdivided as Tflc

sandstone, and conglomerate

five informal members

hackly fracturing to locally fissile

monolithologic tonalite boulder breccia (**Tmeb**)

mostly conglomerate, subdivided as Tpvc

Cobble clasts are red rhyolite

pebbly sandstone, and conglomerate; massive to indistinctly bedded

Miocene)—Sandstone and conglomerate; marine and nonmarine

Soquel Member (Miocene)—Predominately sandstone and siltstone.

poorly bedded sandstone; massively bedded, nonmarine

Santa Rosa basalt of Mann (1955) (Miocene)—Vesicular basalt flows

lenses; greenish-yellow, unconsolidated

Includes one member and two "facies"

Tonalite near mouth of Laborde Canyon (Cretaceous)—Biotite-hornblende

Rachel M. Hauser and Kelly R. Ruppert